Fourth webinar on CSA California – Netherlands

Business opportunities of Greenhouse horticulture as a comprehensive CSA solution

Ministerie van Economische Zaken

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CALIFORNIA DEPARTMENT OF
FOOD AND AGRICULTURE

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WELCOMING & OPENING REMARKS

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USDA California Climate Hub

Dr. Neli Prota
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Business challenges of Greenhouse Horticulture

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Business challenges of Greenhouse Horticulture

KEY QUESTIONS

- What is the unique selling point that makes protected horticulture and greenhouses a good climate Smart Ag solution?
- What is the current status quo (technology, applications, legislations) in the two regions?
- What are the cutting edge innovations (Ag tech, hardware, growing) in green growth in protected agriculture and how do they answer the 3 pillars of CSA (mitigation, adaptation and sustainable production)?
- What is in it for CAL and NL? Can partnerships be established and in which specific sectors and under which enabling conditions?

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A HIGH TECH APPROACH
- THE INPUTS AND OUTPUTS

Prof. Dr. Heiner Lieth
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Dr. Silke Hemming
Wageningen University and Research

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Business challenges of Greenhouse Horticulture

Climate Smart Controlled Environment Agriculture

Dr. Heiner Lieth

Professor and Extension Specialist of Environmental Horticulture

Plant Sciences, UCDavis

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Protected cultivation

- The type of farming where we improve some or all the factors that affect how the plant grows
- Objective for this type of farming:
  - Reduce plant stresses (primary)
    - Eliminate extreme temperature, light, wind, etc
    - Eliminate pests and diseases
  - Optimize conditions (if possible)
    - Impose best possible temperature, light, CO_2, etc
- Input costs and gross return are higher
  - “Return On Investment (ROI)” can be better

Controlled Environment Agriculture

- Controlled Environment Agriculture (CEA)
  - A system of plant production technologies that enable full control of the environment surrounding the plants, both in the rootzone and above
  - Protected Cultivation
    - A horticultural system where plants/crops are protected from harmful biotic and abiotic influences
  - CEA goes beyond “protection” and aims at total control over the system.
  - Note that when looking for statistics, much of this agricultural activity is considered “Specialty Crops”
- Includes: Greenhouse, tunnels, in-door, nursery
  - Various levels of protection or control

Protected cultivation types

- “cold frames”, “tunnels”

- shade house
- screen house
- All these plastic film/ screen
- Feasible under mild conditions.

Plastic greenhouses

- Structure can be much lighter (less expensive)
- Single or double layer transparent plastic; film, sheet
- Used extensively in California; in Europe primarily southern countries (eg Spain)

Glass greenhouses

- More expensive
- Better in winter
- These are buildings with transparent roof and walls

Indoor Agriculture

- In a building with a conventional roof (not transparent)
  - Sunlight is not used to provide plants with PAR
  - Instead lamps are used to make light
- Emerging technology – feasible due to:
  - Advanced lighting technologies
  - Advanced soilless culture methods
  - Advanced tools for air handling (CO_2, humidity,…)

All types of transparent cover cause “greenhouse effect”

- Greenhouse effect:
  - All radiation entering from the sun passes through cover
  - Radiation from inside the enclosed structure leaves at lower rate (long wave radiation, less shortwave)
  - Effect: net trapping of energy
  - This energy builds up and within minutes of full sunshine the interior is so hot that it will kill plants and animals
- Greenhouses which are used to grow plants and animals must be equipped to remove heat
  - All greenhouses are flow-through systems where outside air is pulled through so as to push hot air out
  - CO_2, water vapor, etc., travel with this air stream

Removal of trapped heat

- Passive (venting) => Active cooling (fan and pad)

- Not cheap! In California, the cooling cost can be as great as the winter heating cost.
- As “Climate Smart” approach, this cost is a key element; if ROI is not insured, then this is not a feasible system

Some opportunities

- Hybrid system: Greenhouse/Nursery + Solar PV
- Many specialty crops benefit from some shade in summer.
  - Opportunity: take excess light and use its energy for profit
  - Prototype has been built (located at UCDavis)

Some opportunities

- Hybrid system: In-door plant factory
- Grow specialty crops (high value horticulture)
  - Opportunity: innovations in LED lighting are making it possible to grow many more crops in-doors (no sunlight, no pesticides, very high water-use efficiency, high growth rates) – regardless of climate!!!
  - Research is needed to help growers adopt technology
    - Which crops have ROI?
  - Prototype at UCDavis

Some opportunities

- Hybrid system: In-door plant factory + Greenhouse
- Grow specialty crops (high value horticulture) using both tools in optimized way.
  - Opportunity: start plants in in-door setting (no pesticides, extreme water-use efficiency, high growth rates) shift plants to greenhouse to grown on to end of crop
  - Research is needed to help growers adopt technology
    - Still risky
    - Can this result in pesticide-free plant production; higher quality product

Prototype at UCDavis:

Some opportunities

- In California: a large number of greenhouses are being built in areas where the climate is NOT great for greenhouses
  - Specific for Cannabis
  - Plastic greenhouses with lights and black-out curtains
  - At each location they will build as many as the electric supply grid can sustain
- This is an opportunity for CSA
  - Cannabis industry has funds to innovate; try new technologies
- It has already been noted that this segment of ag will be very large, consuming vast quantities of energy and water.

Some opportunities

- Transfer some things we know in CEA to field production:
  - Reuse our irrigation water; discard only when too expensive to clean up
  - Accomplished with soilless culture (substrates which resemble soil but have better water and fertilizer handling properties)
- The CSA opportunity:
  - Develop field production technologies that implement this
- Not as outlandish as it sounds; consider strawberry production

Strawberry field production can use many of the same technologies as greenhouse strawberry production!

How ?

Like so?

- California strawberry with soilless culture:

For more info or questions:

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Smart Climate greenhouses

Webinar The Netherlands – Calofornia

22 June 2017

Dr. S. Hemming, Wageningen University & Research
Greenhouse Horticulture

WAGENINGEN UR
For quality of life

High-value crops, nutritional value

Source: https://www.iamafoodie.nl/minder-voedingsstoffen-groente-en-fruit-dan-vroeger/

Source: Liz Cook, poster to buy at Amazon.com

High-yield and product quality

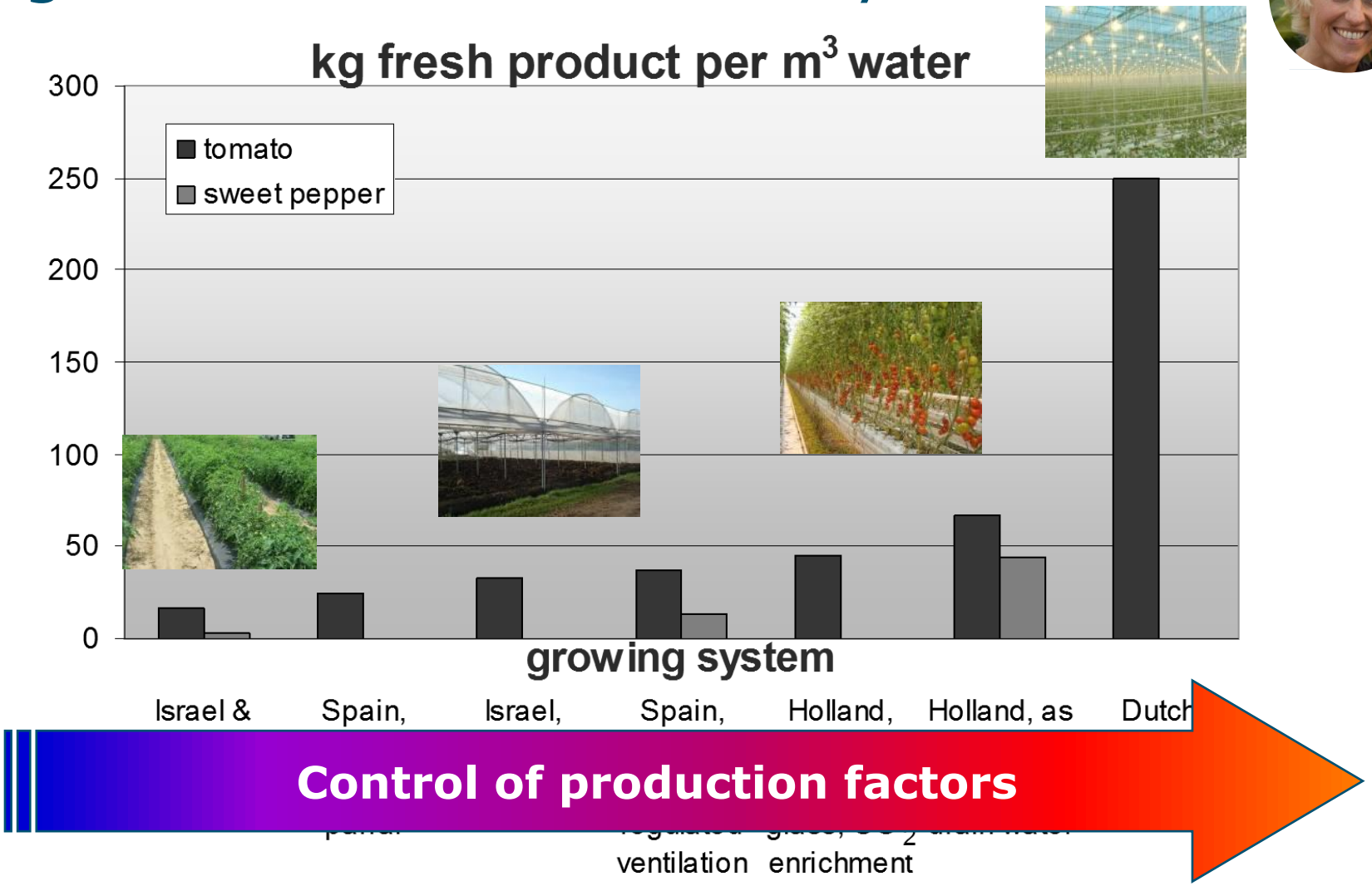
Tomato yield kg/m²·year

80
70
60
50
40
30
20
10
0

Control of production factors

WAGENINGEN UR
For quality of life

High resource-use-effciency



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For quality of life

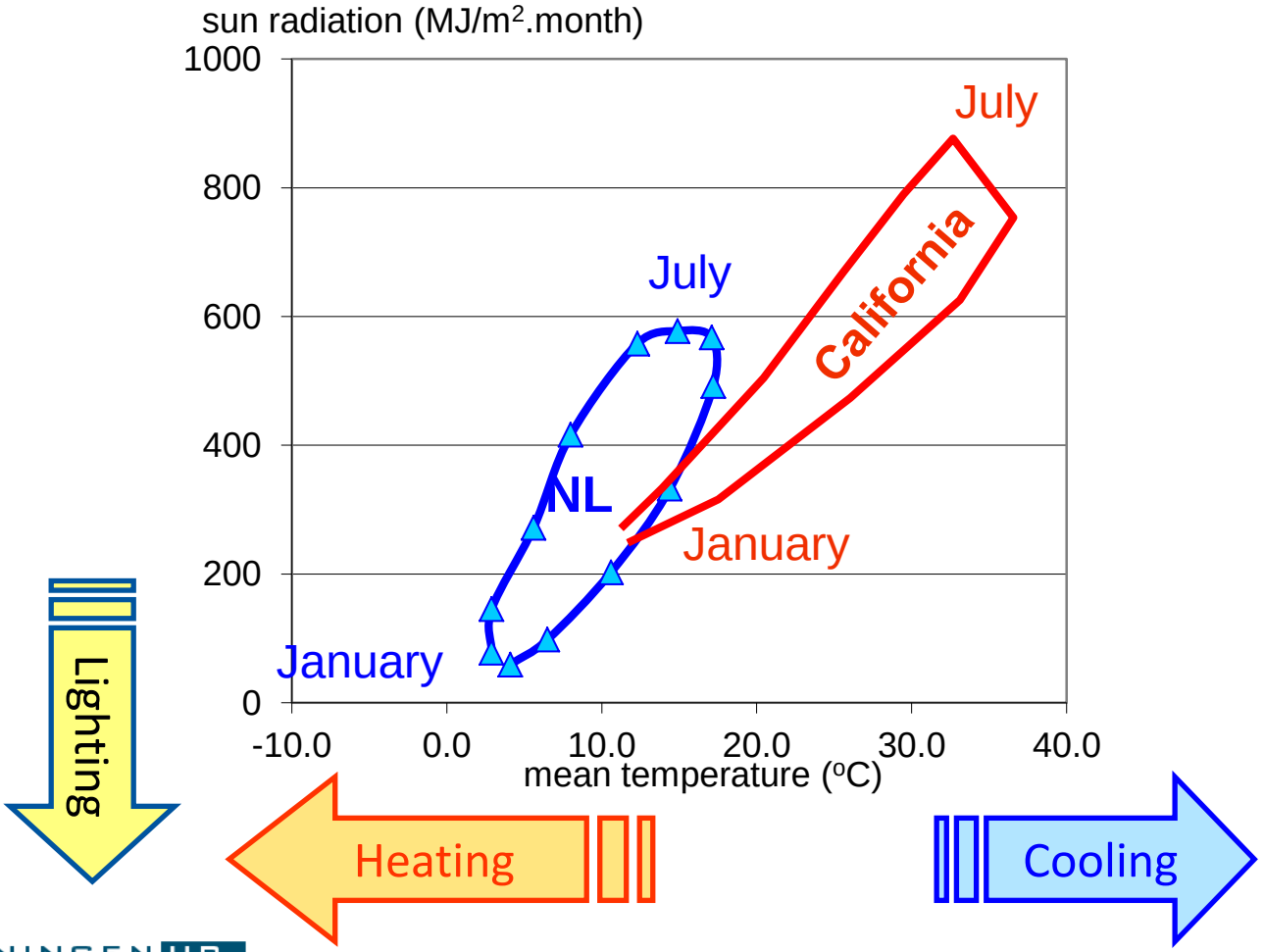
Innovations Greenhouse Horticulture last 50 years (primary production)

Focus: to become independent of...

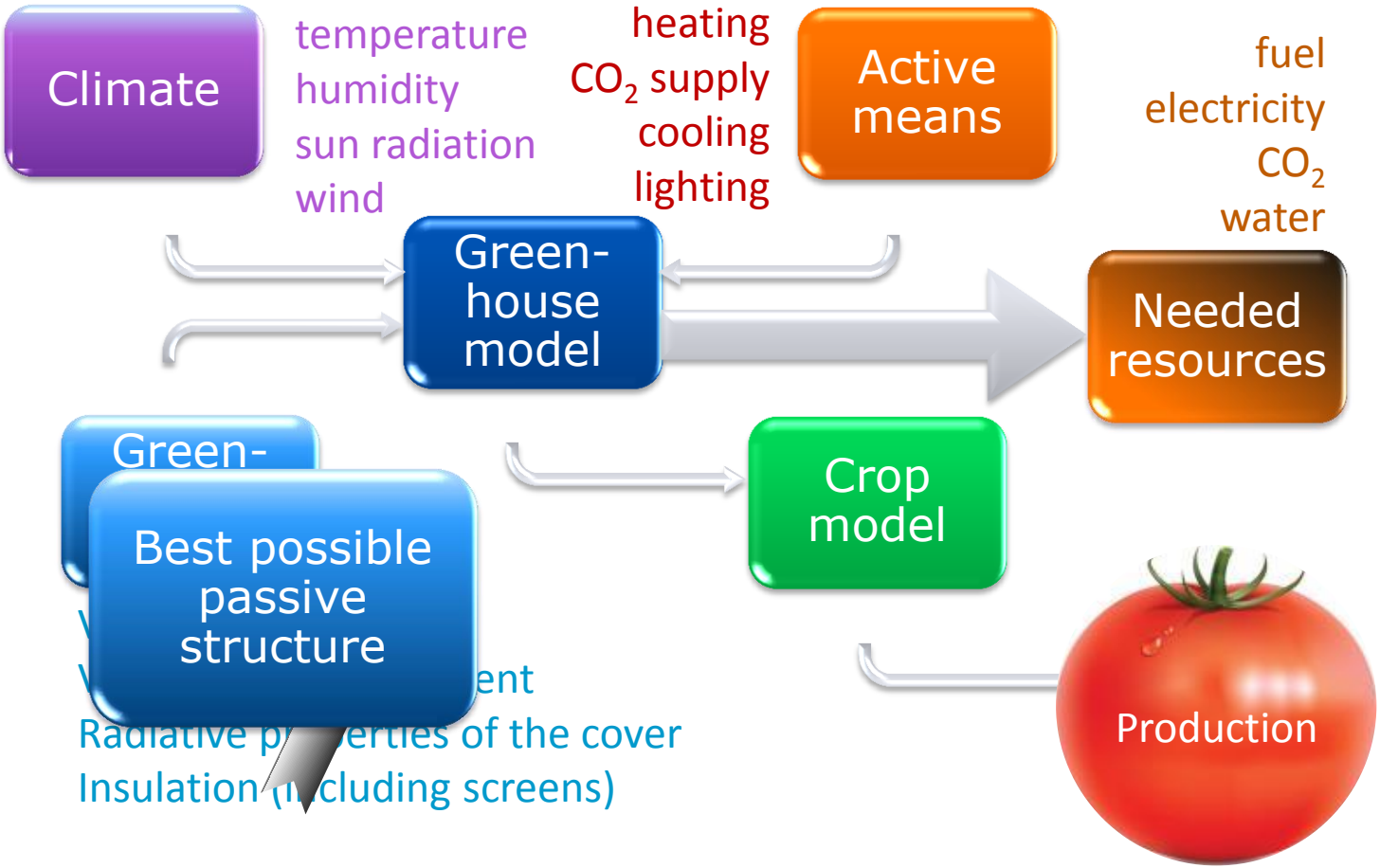
- Soil (substrates)
- Environmental conditions (greenhouses, climate control)
- (Fossil) energy (energy saving, sustainable sources)
- Chemicals (IPM, biological control)
- Labour (Logistics and robotics)
- Water saving (closed cyles, rainwater storage, water purification), no emissions
- Breeding
- Innovations in trade and logistics

WAGENINGEN UR
For quality of life

From climate conditions to optimum sustainble greenhouse production systems



The adaptive greenhouse method:



Research center in Riyadh

WAGENINGEN UR
For quality of life

Bom Group
Greenhouses - Screening - Climate - Turnkey

sabic

High tech vs Mid tech

Version: 26-4-2017

Variety: Red and Yellow Pepper
Sowing date: 21 December 2016
Planting date: 26 January 2017
First harvest: 27 March 2017

Production

Mid tech	2.9 kg/m2
High tech	4.4 kg/m2
	49%

Water use

Mid Tech	375 l/m2
High Tech	35 l/m2

Water use efficiency

Mid Tech	128.2 l/kg
High Tech	8.0 l/kg

CO2 use

Mid Tech	0.0 kg/m2
High Tech	2.2 kg/m2

Energy use (cooling)

Mid Tech	0.41 kWh/m2
High Tech	73 kWh/m2

Greenhouse Horticulture: Vegetables

POLICY and REGULATIONS

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The Dutch approach

Energy innovation for the Dutch glasshouse industry

Kas als Energiebron

22 June 2017

Leo Oprel

Ministry of economic affairs

The arrangement

- *Kas als Energiebron* is the innovation and action programme for energy saving and the use of sustainable energy for the Dutch glasshouse industry. *LTO Glaskracht Nederland* (the growers) and the ministry of Economic Affaires initiate, facilitate and co-finance this programme.

- *Kas als Energiebron* works on long term legal agreements between the government and the sector
- Yet the Meerjarenafspraak Energietransitie Glastuinbouw 2014-2017 is an agreement that contains goals and ambitions up to 2020. A new agreement for the following period is under construction.

- The long term goal is a glasshouse industry without CO_2 emission in 2050, according to the Paris agreements

Co-creation and co-altion

- Clear goals (2020 6.2 Mt CO_2, 2030 ?, 2050 0)

- Subscribed goals (the future is of all that are involved)

- It must be made possible. Ahead knowledge borders

- Total set of instruments
- Knowledge development
  (Research, Proof of Principle, demo-centre)
- Dissemination of new knowledge
- Subsidy for innovators (market introduction)
- Subsidy for proven techniques
- Subsidy for geothermal and other sustainable energy

How

- Trias Energetica – 1st energy saving, 2nd sustainable energy, 3rd rest with optimal fossil fuel (for the time being)

- Earlier years : transition paths
- Later and now: integral but modular

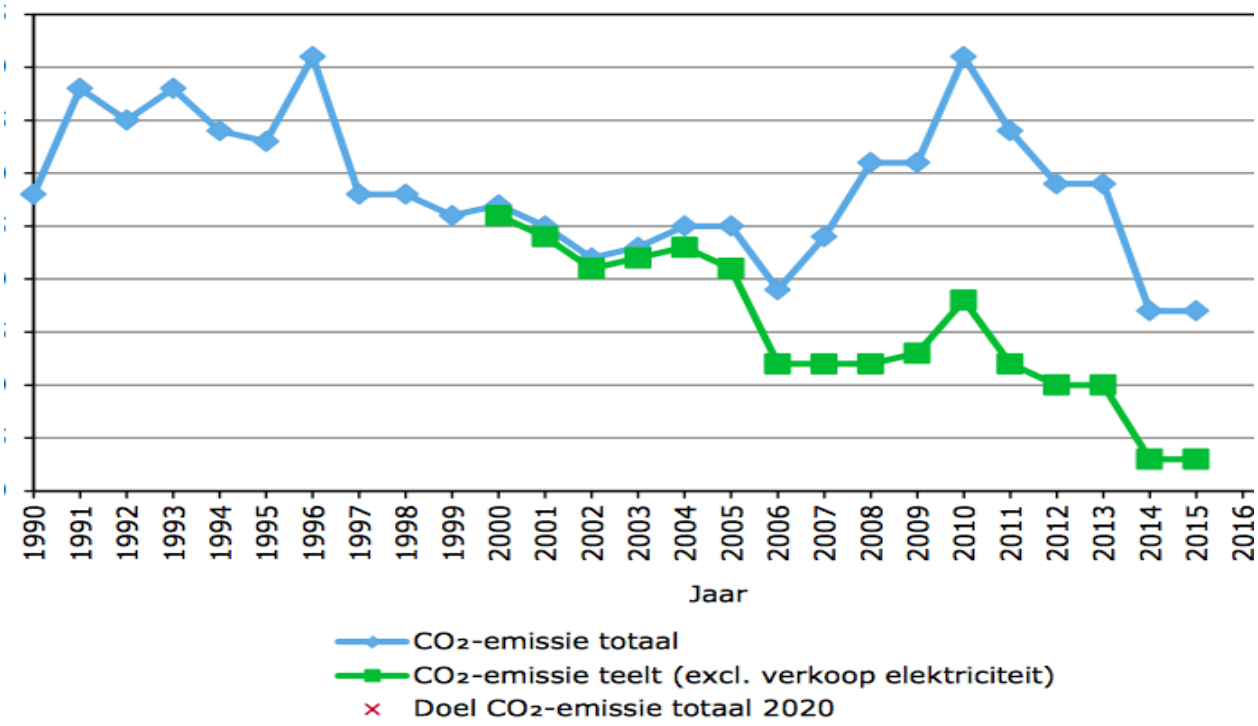
- Research steering on CO_2 (since 2004)

- Operating and thinking from the actors' perspective (human included)

- Using innovators to convince the others

Governments policy: money and direction for a real transition

- Stable course, even with low energy prices
- Long term agreement and budget – transitions cost time
- Active role of the governmental officers in research direction
- Redirect yearly
  - subsidies adjustments
  - research adaptation to new developed knowledge
- Trust and imagination
- Networking (keep all involved)



Results count

The new way of growing, new glasshouse concepts, new energy-saving screens, breakthroughs in plant physiology , more and better production, less CO_2 emission and more sustainable energy

INSIDE THE INDUSTRY

Joep van den Bosch, BSc
Hortimax

David Bell
Houweling's

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Ridder-HortiMaX Group

Greenhouse Growing Knowledge & Technology

www.ridder.com

Joep van den Bosch, Chief Innovation Officer
Webinar Climate Smart Agriculture
June 22, 2017

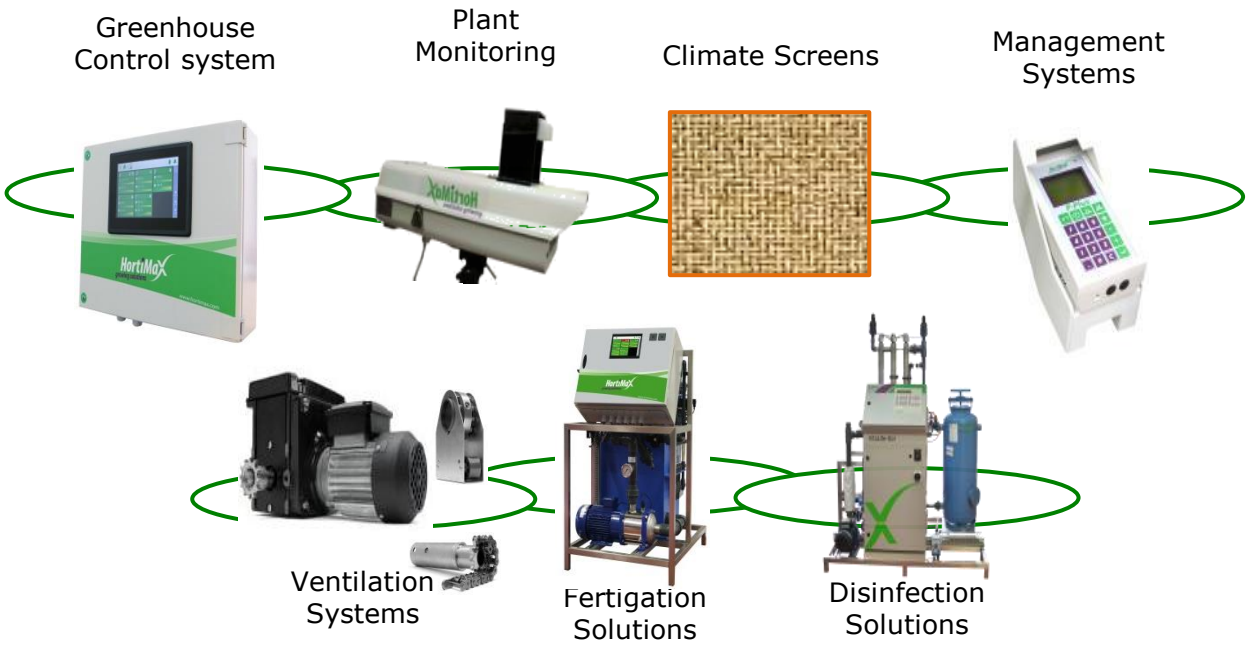
HortiMaX growing solutions

RIDDER drive to innovate

Ridder-HortiMaX Group
Global leader in greenhouse technology

Design, build and maintain greenhouse technology solutions in:

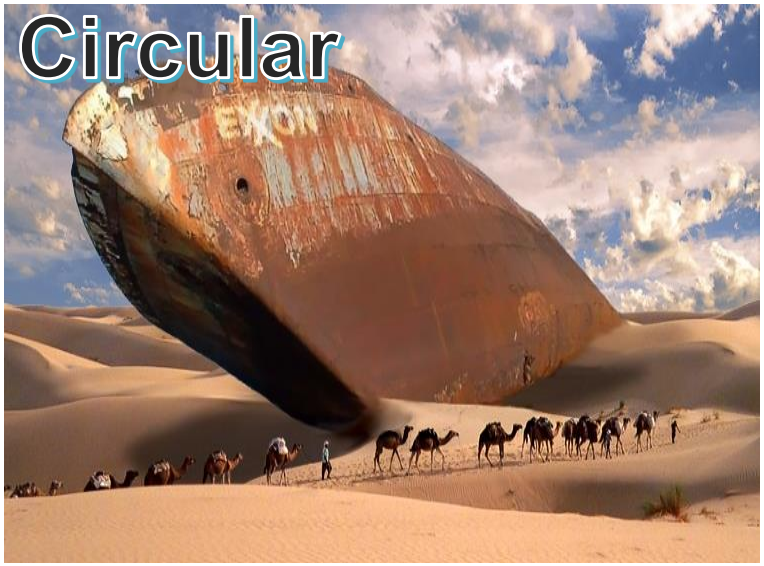
Water management
Climate management
Energy management
Labour management
Business intelligence



Large global customer base

Climate Smart Agriculture

Fresh food production needs controlled environments



Climate Smart Agriculture
Need for adaptive greenhouse technology

Greenhouse structure

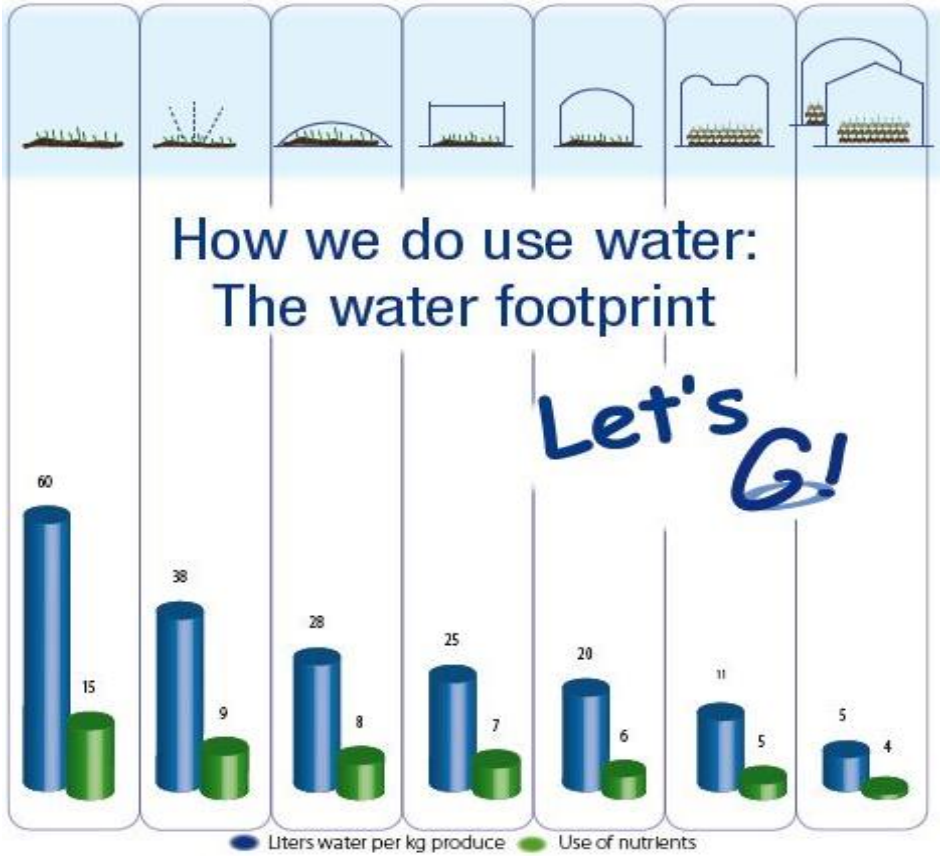
High Investment
Maximum yield
High quality
Predictable yield

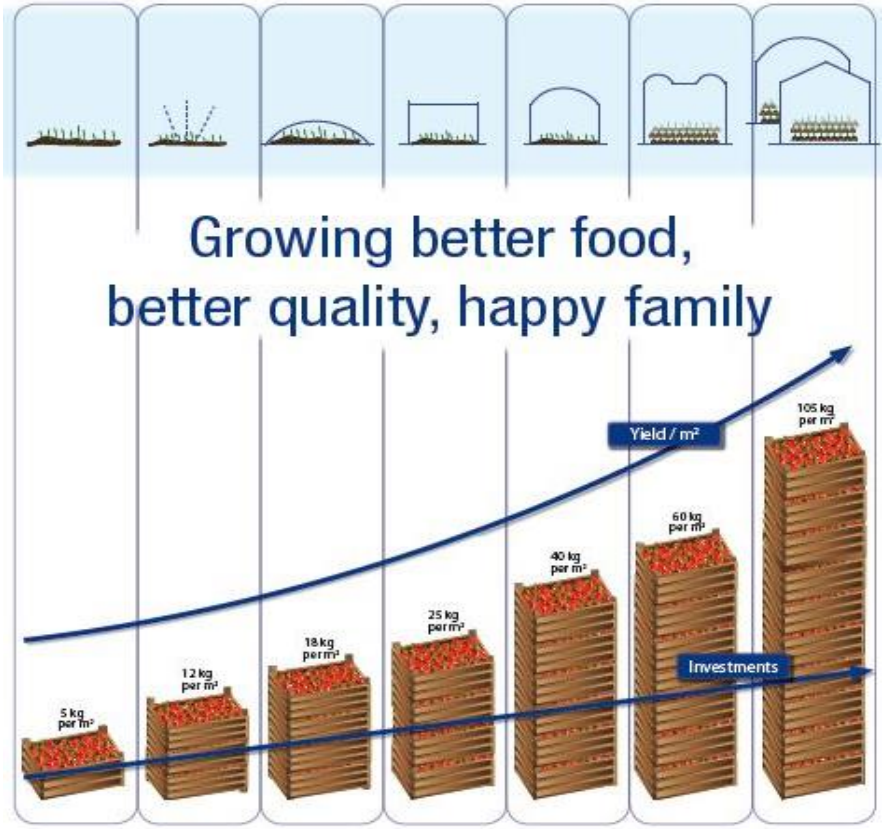
		Active - Low tech	Active - Medium tech	Active - High tech
Glass Greenhouse	*(Semi) Closed GH* *Venlo* *Widespan*			**Closed greenhouse** **Supplement light/LED** **Forced ventilation**
Poly Greenhouse	*Widespan* *Gutter connected*			**High pressure fogging** **Central heating** **Climate screening**
High Poly Tunnel	*Freestanding*			**Local heating** **Motor ventilation** **Natural ventilation**
Simple Protection	*Shade and Nethouses* *Walk-in and Low tunnels* *Direct Cover and Mulch* *Solar lean to green*			**Automated fertigation** **Automated irrigation**
Open Field				

Low Investment
Low yield
Survival of the crop

Inside technology

Climate Smart Agriculture
Need for state-of-the-art greenhouses





Source: Wageningen University Research

Climate Smart Agriculture

Comparing high-tech greenhouses and vertical farming

High-tech glass greenhouses

- Significant lower investment cost per m2
- More energy efficient due to:
  - Use of natural light
  - Active ventilation versus HVAC
- Lower labor cost per kg product

Vertical farming

- Best solution for extreme climates
- No influence from outside weather
- 100% controllable indoor climate
- Automated growing on fixed recipe

COMPANY OVERVIEW

Greenhouse Goodness

- Houweling's grows a wide array of tomatoes and cucumbers from staples such as Tomatoes on the Vine, Roma, and Long English Cucumbers to our Sweetoms Grape Tomatoes, Snacking Medleys, Signature Heirlooms and more
- Each Variety is harvested ripe in our greenhouse to achieve the best flavor, consistency and quality that our fans have come to love and demand
- Over 200 acres of year-round, intercropped greenhouse tomatoes and cucumbers

Houweling's Farms

- Delta, BC (50 acres)
- Abbotsford, BC (15 acres)
- Mexico (60 acres)

Partner Farms

LEADERSHIP IN SUSTAINABILITY

Sustainability Highlights

Our respect for the earth inspires us to innovate and invest in sustainable practices. Our vision for sustainability is based on the principles of environmental soundness, economic feasibility, and social equity.

- Year-round locally grown tomatoes results in drastically fewer emissions related to freight in comparison to imports.
- Hydroponic irrigation & recirculation results in 1/6th the water usage vs. field grown.
- Ability to capture and store rainwater and run-off in 4 acre retention pond and use for irrigation (CA)
- Annual production of 125 acre GA farm is the equivalent KG to over 3000 acres of field.

MASTERY UNDER GLASS
Craig Howeling
HOUWELING'S TOMATOES™

GROWING A GREENER TOMATO

One of North America's largest greenhouse tomato growers, Houweling's Tomatoes, built the first combined heat and power (CHP) greenhouse project in the U.S. that captures carbon dioxide (CO_2) for use in plant fertilization.

NATURAL GAS

JENBACHER J624

Three GE ecomagination-qualified Jenbacher J624 gas engines

CO_2 FERTILIZATION PROCESS

CO_2 from the engine's exhaust is purified and piped into the greenhouse as fertilizer, diverting 32,100 tons of CO_2 yearly, equal to **yearly CO_2 emissions of more than 6,000 cars**.

HEAT

Heat produced from the engines during power generation — more than 15.9 MW of thermal power — is captured in thermal storage tanks and used to heat the greenhouses.

POWER

The gas engines provide 13.2 MW of electrical power — **enough for approx. 13,200 average homes** — to meet greenhouse needs and supply energy back to the community grid.

CONDENSED WATER

Water is condensed out of the exhaust gas system, conserving water from the Central Valley, to provide approx. **14,250 gallons of water per day** to greenhouse operations.

FROM WASTE TO VALUE

The process provides power, heat, water and CO_2 fertilization for Houweling's Tomatoes' 125-acres in Camarillo, CA.

COMMUNITY POWER GRID

WWW.FACEBOOK.COM/HOUWELINGSTOMATOES

WWW.TWITTER.COM/@HOUWELINGS_ & #365GREEN

WWW.HOUWELINGS.COM

UTAH'S CROWN JEWEL OF ENERGY INNOVATION

HARNESSING WASTE ENERGY:

- Flue gas from Currant Creek power plant stack are diverted to Houweling's via above ground duct
- Thermal energy is stored on-site for greenhouse heating on-demand
- Waste CO_2 is directed into greenhouse to promote plant growth
- Condensate captured and utilized to supplement irrigation

HOUWELING'S UTAH H_2O

- Flu Gas Condensate (8.3 million US gallons annually)
- Condensation Recovery (off the inside of glass)
- Potential Rainwater Capture
- Well Water
- No Ag run-off, 100% recycled

PANEL DISCUSSION

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Student Challenge:

Design the ultimate urban greenhouse

Students are being challenged to submit an urban greenhouse design which brings professional food production into urban neighbourhoods, connects it with local energy systems and encourages citizens to engage with sustainable production and consume healthy food.

Registration between 1st and 31st October 2017

Check out www.wur.eu/studentchallenges

WAGENINGEN UNIVERSITY & RESEARCH

100years

Could you design the ultimate urban greenhouse?

Wageningen University & Research is organising a Challenge to Design a Sustainable Urban Greenhouse.

Who for? Students in relevant fields at universities or universities of applied sciences

What's the challenge? Submit an urban greenhouse design which brings professional food production into urban neighbourhoods and encourages citizens to engage with sustainable production and consume healthy food. Spark the future, improve the quality of life!

When's this happening? Register between 1st and 31st October 2017. You will present your design for an expert jury during the last week of August 2018.

What's next: Start putting together your dream team now and get ready to Design a Sustainable Urban Greenhouse.

Check out www.wur.eu/studentchallenges

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100years

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